EDITO Model Lab – General Assembly

16-18 January 2024

CMCC Headquarters in Lecce, Italy (hybrid)

https://events.edito.eu/

DAY 1 – 16 January 2024 – Achievements and upcoming Plans

Opening

- **Z Konstantinou, N Segebarth (European Commission):** Key upcoming step is June 2024 Digital Ocean Forum demonstration. We need to demonstrate to the community some results. That we are making something useful for the stakeholders and the whole community.
- **N Pinardi (UNIBO):** In the Forum we should make clear the usefulness of the work done in EDITO (the added values of the EU DTO). The services should be accessible and equal for the users.

WP1/WP8 - Achievements and next steps - Project Management and Communication-Dissemination-Uptake

- **Y. Drillet (MOi):** Development of key components of the DTO. Objectives of the EDITO Model Lab project. Close cooperation of Horizon Europe projects EDITO-Model Lab and EDITO-Infra. EDITO will deliver an integrated platform and new services. New tools and new dataset to deliver to the community. 13 partners from 8 countries with multiple expertise. 8 WPs. 2023 marked by finalization of Design phase. 2024 will be dedicated to Integration. 2025 will be dedicated to Demonstration.
- **M. Malicet (MOi):** Resume of all the achievements. WP1 technical coordination with a list of meetings. Data Management. FAIR dataset. Workplan for 2024 -> Deliverables of WP1. Milestones and reports. NVIDIA withdrawal from the project leading to ongoing first amendment of the Grant Agreement.
- **T. Garcia (+ATLANTIC):** Communication and dissemination achievements is part of WP8. 1) disseminate the project's progress, 2) Organize 2 training events and 3) supporting key global ocean initiatives (Internationalization). Top challenge is to get significant visibility. EDITO project was present in many international events this year (2023). Social media is very important. It is an easy way to reach a lot of people. Converting results in news articles on the web. Finalization of the editorial plan.

- **Discussion:** Several levels of communication and dissemination. Demonstrations, Hackathons, but also need for regular messages on social media also for small achievements but that demonstrate the added value of the project.
  In particular:
- Advisory Board member Sara Garavelli (CSC IT Center for Science, Finland) was interested to know the Project is planning to demonstrate the added-value of EDITO.
- Nicolas Segebarth (EC, DG RTD) suggested to orient the communication regarding the Project developments on the new features that EDITO will be bringing (what is now feasible that was not before).
- Anabela Oliveira (LNEC Laboratório Nacional de Engenharia Civil, Portugal) raised that EDITO needs simple workflow thus to limit this powerful tool and was wondering how this can be done.

WP2/WP3 - Achievements and next steps - AI and Models

- **R. Fablet (IMT):** Deep Differentiable Emulators. AI/DL into the DTO core suite both for ocean modelling and data assimilation tools. 1) Improving ocean models. 2) simulation, forecasting and reconstruction. 3) ocean data assimilation and case studies (Lagrangian Drift, sea surface dynamics, ecc.). 1)parameter calibration with DDE blocks for OGCM parameterization. Training

neural closures with DDEs for non-differentiable codes -> improve long-term stability. Emulators to deal with non-differentiable LES models. 2) DL approach to forecasting and reconstruction problem. End-to-End emulator. Mapping and short term forecasting of sea surface dynamics. Emulation of PISCES. Training dataset to build training for each target variable. Emulator for the whole PISCES or emulate each variable. Lagrangian Drift simulation with an emulator. Better exploiting observations in ocean DA systems.

- **Discussion:** There should be some background probably to use AI/DL tools in EDITO.
- **D. Greenberg (Hereon):** Deep Differentiable Emulators (DDE), Hybrid Emulators, Progress in Emulation of NEMO. 3 common tasks for DDE -> 1) Data Assimilation (Initial condition). 2) Model tuning. 3) Learning corrective terms. Optimization problems. 1) Find a sequence of system states that matches both model and data. How to obtain derivatives of the state update function M: 1) generate simulations. 2) train a neural network to emulate the state update function. 3) differentiate the neural network's outputs. NN is promising for Data Assimilation. Hybrid models that incorporate Machine Learning and numerical models.
- **Discussion:** Is the system flexible to train other models than NEMO, for instance unstructured models? High desirable.
- **I. Federico (CMCC):** Develop and Consolidate ocean numerical models with optimization, calibration and validation. 1st year of co-design. 2nd year of prototype. Model developments: Physics, Numerics, Integration couplings, technological, computational. Different ocean configuration for DTO models: Adriatic Sea, Baltic Sea, North Sea and Global configurations with NEMO and unstructured grid. Developments of sea-ice components for unstr. Grids. Global configurations for waves unstr. Regional application in Adriatic Sea -> Wave-Hydrodynamics coupling and Vegetation modules in northern Adriatic Sea. Coupling between SHYFEM and BFM. WAM In Black Sea and SCHISM in coastal western Black Sea. Southern North Sea with SCHISM and German Bight SCHISM-WWM coupled model. Delft3D-FM including water quality and morphology modules-> DCSM and DWSM. HBMos in Baltic-North Sea. 1st year achievements: finalization of the design phase of development. Optimization of Model Efficiency: 1) NEMO ORCA conf. 2) Unstr. Grid models. 3) evaluate of model scalability and performance with an assessment campaign. 2nd year workplan: 1) Design of validation method. 2) Validation implementation. 3) Reporting and publication (M24). Validation/calibration of models with satellite and in-situ observations.
- **C. Bricaud (MOi):** WP3 example: the global 1/36 NEMO simulation. Present CMEMS/MOI global configurations. Global ¼ degrees (20-25km), Global 1/12 (6-9km), Global 1/36 (2-3 km). The next global 1/36 will resolve the 1st Rossby radius (away from coast). Need to add tides (internal tides almost resolved). Eddy-Resolving model. Multi-year hindcast. Tests with and without tides. Run on ECMWF/ATOS computer: 25600 cores. 2 months per day. Kinetic energy increase with model resolution. ORCA 36 resolve 7 baroclinic modes. Model improvements. Changed time-stepping. From leapfrog+ Asselin filter (Modified LeapFrog) to new 2 level time-stepping based on Runge Kutta 3rd order scheme. One year of ORCA36 (hourly 2D and daily 3D): 90 Tb, with a year of 3D hourly outputs it increases to 790 Tb. Near Real Time demonstrator based on spectral nudging GLO36V1.

WP4/WP5 - Achievements and next steps - Core Model Suite and Virtual Ocean Model Lab

- **M. Castrillo (BSC):** It combine the co-development and computation features. WP5 and VOML architecture. GUIs -> Model Builders -> autosubmit -> EDITO-INFRA and EUROHPC. Back-end architecture with autosubmit.
- **Demonstration of Autosubmit use**

- **R. Dussurget (MOi):** integration of model suite core collaborating with other WPs. Core model suite and modelling services (VOML) questionnable from the user. Integration and interoperability of the core model suite.
- **NEMO Demonstration:** Run NEMO reference simulation ORCA2 ICE PISCES. Global model with a 2x2 degrees ORCA2 grid 31 vertical levels. Run simulations with post-process XIOS output.

WP6/WP7 - Achievements and next steps - Focus applications and What-if-Scenarios

- **L. Meszaros (Deltares):** Demonstration of the benefits of the developed model components for the mission priorities. **WP6 – Focus Application**: FA1- Habitat suitability in the Wadden Sea; FA2- ship routing for zero carbon, FA3 – oil spill for zero pollution in Med Sea, Microplastic pollution in Baltic Sea. Integration of WPs.
- **J. Staneva (Hereon):** What-if scenarios. 1) Nature Based solutions for biodiversity and coastal hazards. 2) Marine plastic for zero pollution. 3) Aquaculture for zero carbon. EDITO Lab digital twin will be enabled to test the what-if scenarios. Seagrass meadows are an example of nature-based solution for coastal resilience that will be addressed. Digital twin for coastal NBS. Problems and solution to be tested with a digital Twin Modelling framework and then doing what-if scenarios. Hereon – SCHISM-WWM with XBeach model. SHYFEM and WWIII are implemented in northern Adriatic Sea. Deltares also did something for WiS 1. WiS2 is for the effects of marine plastic for Zero pollution. Baltic Sea, North Sea ecc. MOI Surface lagrangian 2D drift tool. Integration of WiS in the EDITO framework. Deliverable at month 24.
- **G. Mannarini (CMCC):** VISIR-2 implementation in a container.
- **Discussion:** Hazard mapping is also very important for WiSs and FAs.

DAY 2 – 17 January 2024 – User Sessions

User Session 1
WiS#1 - Nature Based Solutions for Biodiversity and coastal hazards

User Session 2
WiS#2/FA#3 – Zero Pollution

User Session 3
FA#1 – Marine Protected Areas for Biodiversity

Participants:

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Francesco de Franco	Torre Guaceto MPA		In person
Paolo D'Ambrosio	Porto Cesareo MPA		In person
Nicola Ungaro	Environmental Agency of Apulia Region		In person
Comandante di Vascello Francesco Perrotti	Capitaneria di Porto di Gallipoli		In person
Tenente di Vascello Francesco Walter di Marco	Capitaneria di Porto di Otranto		In person
Prof. Alberto Basset	University of Salento		In person
Prof. Stefano Piraino	University of Salento		In person
Prof. Francesco Mastrototaro	University of Bari		In person
Gaetano Internò	Port Authority of Taranto		In person
Francesco Ronco	Apulia Region		In person
Valentina De Pinto	Apulia Region		In person
Carmelo Calamia	Province of Lecce		In person

User Session S1
WiS#1 - Nature Based Solutions for Biodiversity and coastal hazards

Moderator: CMCC (G Coppini)

1Presentation:

- 1.1 What-if-Scenario in Nature Based Solutions: On-demand modelling for coastal Hazards, HEREON (W Chen) (10')
- 1.2 Nature Based Solutions for Coastal Hazards In Northern Adriatic Sea, UniBO/CMCC (J. Alessandri) (10')

2-Demo:

- On-demand modelling for coastal hazards, esp. High resolu on, on-demand runs for storm surge cases, DMI (J She, V Freshfield) (20')

3-Discussion with users (20')

US1/ Pres. - What-if-Scenario in Nature Based Solutions:
On-Demand Modelling for coastal Hazards, HEREON (W Chen) (10')

Wei Chen (Hereon) presented how can seagrass meadows be used as a Nature-Based Solution to protect the coast from erosion and sea level rise. How does the EDITO-Model Lab WiS can support better decisions and more efficient results? What is the efficiency index developed by EDITO-Model Lab?

Audience asked about the uncertainties associated to the results. This is seen as crucial for the credibility and future exploitation of the results. Also relevant is to be very clear about how each type of users (beta, intermediate, end) can be involved on codesign and then on exploitation. According to Zoi Konstantinou (EC, DG MARE) this can be used as a demonstrator in DOF 2024, but we need very careful on expectations we raise and promises we made: we should promise what we can deliver underlining the innovation but we cannot tell users that they will have a plug and play tool if we cannot deliver one. Nicolas (EC, DG RTD) strengthened the need to be careful about the error margin and uncertainties.

[09:59] Pierre-Yves Le Traon, MOi
Nice presentation. How do you validate results from your what if simulations and/or how are they sensitive to your model set up ?

[10:04] Fabrice Messal, MOi

Thanks for the presentation. Is the JupyterNotebook ready to run the simulation on a different coastal area ? Are there restrictions due to the model ?

[10:14] Marcos Sotillo, NOW Systems : Fully agree with Zoi's comment.

[10:08] Christine Pequignet, Met Office
Maybe working with people who do lab experiment and running the model for a lab configuration will give some ideas. For example at UWA in Australia they have done work on seagrass wave damping

US1/ Pres. - Nature Based Solutions for Coastal Hazards In Northern Adriatic Sea, UniBO/CMCC (J. Alessandri) (10')

Jacopo Alessandri (UNIBO) presented the current situation of coastal erosion and coastal flooding in some Adriatic Italian beaches and how seagrass can be used to fight the problem. The numerical models used serve to understand how each combination of vegetation produce different results and simulate what is expected to happen for specific management measures. Namely, our work shows how can seagrass flexibility can be used to fine tune actions to reduce wave energy in the nearshore.

Audience asked about how Machine Learning will be used and how will it be used in the project's training sessions. Nicolas (EC, DG RTD) asked about the impact of raising temperature can have on this type of NBS.

[10:25] SEGEBARTH Nicolas, EC-DG RTD

Shouldn't the impacts of raising water temperatures be assessed on the choice of NBS ?

[10:27] Laurence Crosnier
Hello, any plan to integarte this use case into the DTO in 2024?

US1/ DEMO - On-demand modelling for coastal hazards, esp. High resolu on, on-demand runs for storm surge cases, DMI (J She, V Freshfield) (20')

Jun She (DMI) presented our two-way nested solution for on-demand modelling for coastal hazards mitigation on the North and Baltic Sea. The models allow to integrate on-demand simulations for specific bathymetry alterations, for example for port management purposes. He highlighted the importance of running stress tests for the models to evaluate errors associated to the simulations. Extreme natural events like 1000-year storm surges and extreme accidents like dyke failure can be simulated. Vilnis Freshfield (DMI) showed how GUI is being used to allow for on-demand simulations demonstrating what can the users do with these tools.

Audience asked what the benefit is of increasing the resolution to up to 40 m grid. Are we getting a lot of improving? Jun showed again the error reduction associated to the new models (from 23 cm to 7 cm).

User Session S2
WiS#2/FA#3 – Zero Pollution

Moderator: CMCC (G Coppini)

1-Presentation:

- FA#3 - Hazard mapping for oil spill pollution in the Mediterranean Sea - UniBO (N. Pinardi) (10')
- WiS#2 - Relocatable Oil Spill Simulations for Zero Pollution, CMCC (Igor Atake) (10')
- WiS#2 - Marine microplastic modelling for zero pollution what-if scenarios, DMI (J Murawski) (10')

2-Demo:

- Marine Plastic for Zero Pollution, MOi (S Van Gennip) (20')

3-Discussion with users (20')

US2/ Pres. - FA#3 - Hazard mapping for oil spill pollution in the Mediterranean Sea – UniBO (N. Pinardi) (10')

Nadia Pinardi (UniBO) presented Hazard mapping for oil spill pollution in the Mediterranean Sea. The goal of this FA is to pre-simulate the release of oil and assess its impact on the environment, to prepare a response for emergency and recovery plan. The presenter showed two products that were developed in the last year: Product 1, which identifies the oil release points for hazard mapping and calculates the trajectory of the oil, and Product 2, which shows the cumulative oil spill trajectories over time. The presenter also explained how the products are hosted in the EDITO-infra project, next to the EDITO-Model Lab, and how they are delivered to the EDITO network / platform. The presenter demonstrated the

Coastal oil spill hazard index, which visualizes the simulation results on a map and provides statistics on the affected coastline. The presentation also included a YouTube video and some considerations on the production steps and requirements to release the products in summer 2024.

US2/ Pres. - WiS#2 - Relocatable Oil Spill Simulations for Zero Pollution, CMCC (Igor Atake) (10')

Igor Atake (CMCC) showed how many oil spills happen around the world and how important is to act quickly after the accident happens. The EDITO-Model Lab solution is a relocatable HR modelling system that tells the user what is expected to happen in the short term. Igor ran a demo for a concrete oil spill from a vessel and what can the user customize. Giovanni Coppini (CMCC) highlighted how the system starts with Copernicus and then, through several steps, is downscaled until the needed resolution for onsite action. User from Porto di Gallipoli Users showed interest in the possibility to get specific simulation information related to the type of oil.

US2/ Pres. - WiS#2 - Marine microplastic modelling for zero pollution what-if scenarios, DMI (J Murawski) (10')

Jens Murawski (DMI) presented Microplastics in the Baltic Sea and explained the difficulty in identifying where the microplastics come from, in contrast with oil spills in which normally the source is well known. The model simulates the drift of microplastics that are denser and lighter than seawater (the first sink, the

second float). Jens showed validation results that allow to identify what can the model simulate with confidence and not. The system allows for example to study what will happen to microplastics in the Gulf of Finland if a main river discharge is reduced to 50%. Also, it calculates the individual contribution of each river to the total amount of microplastics.

US2/ Demo - Marine Plastic for Zero Pollution, MOi (S Van Gennip) (20')

Simon Van Gennip (MOi) presented a demo of Marine Plastic for Zero Pollution showed how big is plastic pollution on the surface of the global ocean and how ocean circulation is key to explain where it accumulates. The modelling system starts with plastic waste input from continental and riverine waste and then relates that with ocean circulation models. This allows for example to assess how local plastic removal actions will change the situation. The same for massive plastic inputs into the ocean in any point of the globe. Example: if India reduces its riverine and continental inputs to 50% what will be the consequence in Sri Lanka? Simon showed how the user can explore, contribute, and create simulations.

Audience highlighted the need to add biofouling to the model since it is the main cause of plastic sink in the ocean. So, the model needs to evolve from 2D to 3D.

Audience also raised the need to pursue efforts to raise awareness on EDITO within international discussions (UN Decade, Regional Seas Conventions, etc.).

[12:36] Laurence Crosnier
nice last slide with the "Explore/Contribute/create" user point of view; all use case should have the same slide

[12:41] Audrey Hasson
Hi, the negotiations are not linked with the UN Decade but rather with UNEP

User Session S3
FA#1 – Marine Protected Areas for Biodiversity

Moderator: CMCC (G Coppini)

1-Presentation and demonstration

- FA#1 Habitat Suitability Mapping in the Wadden Sea (F Dols) (20')

2-Discussion with users (20')

US3/ Pres-Demo - Habitat Suitability Mapping in the Wadden Sea (F Dols) (20')

Felix Dols (Deltares) presented the habitat suitability mapping in Wadden Sea. Shallow seawaters like coastal lagoons must be protected since they are very important for biodiversity's nursery, food, and shelter. The model system combines environmental data, ecological processes, and impact assessment tools. Felix made various demonstrations on how the EDITO platform can already be used to simulate hydrodynamical and biogeochemical processes in coastal lagoons.

Felix also showed how can the user explore, and visualise models and its outputs, contribute with new model configurations or run models on-demand, and finally create services to end-users.

While specific data such as species (seagrass, etc.) information are already available in repositories, the added-value of EDITO is to expand this knowledge bank with complementary variables from other models, to upload simulations or apply and extend the rules (including aggregation), but also to make information more easily accessible and under one roof, through cloud computing. D-EcoImpact module is used to create weighted habitat suitability maps for a variety of marine species, the exemple of Zosteria Marina seagrass in the Wadden sea is presented as the Focus Application under development in the project.

The question of the duration of the running process was also raised.